

GAO

United States General Accounting Office

Testimony

Before the Subcommittee on Investigations and Oversight,
Committee on Science, Space, and Technology,
House of Representatives

For Release on Delivery
Expected at
1:00 p.m. EDT
Thursday
April 30, 1992

ENERGY R&D

**DOE's Prioritization and
Budgeting Process for
Renewable Energy Research**

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Mr. Chairman and Members of the Subcommittee:

We appreciate the opportunity to appear before you today to discuss the results of our review of the Department of Energy's (DOE) planning and budgeting processes for renewable energy technology research and development (R&D). DOE conducts research programs for each broad renewable energy technology area, including photovoltaics,¹ wind energy, and geothermal energy.

As you requested, Mr. Chairman, my testimony will primarily describe the process that DOE employed in developing its fiscal year 1993 budget. I will also briefly discuss how DOE incorporates specific congressional directives into its R&D programs for renewable energy technologies. These issues are discussed more fully in a report that we issued yesterday.²

In summary, we found the following:

- Historically, DOE has based its annual budget for energy technology R&D--which includes not only renewable energy technologies but also those based on fossil fuels and nuclear energy--primarily on the preceding year's budget request, adjusting program amounts to reflect specific initiatives or emphases. However, starting with the fiscal year 1993 budget, DOE initiated a multiyear strategic planning process and assessed research programs, on a departmentwide basis, against the objectives of the National Energy Strategy (NES). The NES, completed in February 1991, expresses DOE's overall approach for meeting the nation's future energy needs.
- The Assistant Secretary for Conservation and Renewable Energy recommends how funding should be allocated among these programs, basing his recommendations on the results of an internal planning and budgeting process. This process incorporates both short- and long-range R&D plans, the views of laboratory managers engaged in the research, and the recommendations of industry groups, utilities, and other end-users of renewable energy technologies.
- DOE ensures that congressional directives³ on renewable energy are followed by incorporating them into program plans and

¹Technology that produces electricity from sunlight without the need for moving parts, such as generators or turbines.

²Energy R&D: DOE's Prioritization and Budgeting Process for Renewable Energy Research (GAO/RCED-92-155; April 29, 1992)

³We define directive to mean guidance in reports accompanying legislation as well as statutory requirements.

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authorization documents for field work by its laboratories. To test DOE's compliance with congressional directives, we judgmentally selected five directives representing different renewable energy technology research programs and tracked them through DOE's system. In each case, we found that the funds for the congressionally directed activities were included in the relevant DOE plans and in documents that authorize the transfer of funds to DOE field offices.

Let me now describe these findings in more detail.

DETERMINING R&D FUNDING FOR
ENERGY TECHNOLOGIES

DOE conducts R&D programs for a variety of electricity supply technologies, including those based on renewable, nuclear, and fossil energy sources. These civilian R&D programs are carried out within the offices of Conservation and Renewable Energy, Nuclear Energy, and Fossil Energy, respectively. Each office is headed by an Assistant Secretary and oversees groups of R&D projects carried out by national laboratories, universities, and private industry. As you know, Mr. Chairman, DOE's budget request for energy technology R&D for fiscal year 1993 includes \$247 million for renewable energy, \$310 million for nuclear energy, and \$811 million for clean coal technology and other fossil fuel research.

The Office of Management and Budget (OMB) provides DOE with overall policy and budgetary direction, including budget planning targets. The OMB targets, which are based primarily on the preceding year's budget, are given for broad spending categories, such as "general science" and "atomic energy defense activities," as well as for more detailed categories such as energy supply research and development and energy conservation.

Using the preceding year's budget request to the Congress as a guide, DOE's Office of Chief Financial Officer allocates the OMB spending targets among DOE program offices. Guided by these targets, program offices and research laboratories then propose research agendas that may include new initiatives or increased funding for a particular research program or programs. In this "bottom-up" process, each program office develops proposals for three funding levels--one that meets the budget target, one below the target, and one that exceeds the target. The latter includes funding for program activities that cannot be funded within the target level but that DOE program managers consider essential.

The Secretary meets individually with each of the Assistant Secretaries to review his or her program office's priorities and funding level recommendations. The Deputy Secretary, the Under Secretary and the Deputy Under Secretary for Policy, Planning and Analysis, and the DOE Controller advise the Secretary on the overall budget. The Secretary ultimately approves the funding

levels for the program offices. The approved budget proposal is sent to OMB for review before it goes to the Congress.

Before the start of the fiscal year 1993 budget process, DOE had identified weaknesses in its departmentwide planning and budgeting process. For example, in documents accompanying DOE's fiscal year 1991 budget, the Secretary stated that DOE had no departmentwide long-term program planning. Furthermore, the Secretary stated that DOE had "no good way" to establish budget priorities, a position reiterated to us by DOE officials in a previous review of DOE's R&D budget allocation methods.⁴

TYING FISCAL YEAR 1993 BUDGET TO NES OBJECTIVES

As a result of this agency's planning and budgeting process, DOE linked energy R&D program funding priorities to NES objectives when it developed its fiscal year 1993 budget request. According to officials from DOE's Office of Policy, Planning and Analysis, the fiscal year 1993 budget process represented a significant departure from previous years in that it involved departmentwide planning and prioritization--in their words, a "corporate view" of DOE civilian R&D programs.

The NES reflects four broad objectives: (1) improving energy supply and demand efficiency in a way that promotes economic efficiency, (2) reducing the adverse economic effects of oil supply disruptions, (3) strengthening the basic science research effort, including scientific education and technology transfer, and (4) enhancing environmental quality. Let me say, Mr. Chairman, that we did not, as part of this review, assess the merits of the NES or its goals. However, as we have previously testified and reported, we do have some concerns about the underlying analytical support for NES options and some questions as to whether the NES will succeed in achieving its energy efficiency goals.⁵

Strategic Planning Initiative

⁴See Energy R&D: DOE's Allocation of Funds for Basic and Applied Research and Development (GAO/RCED-90-148BR, May 1990).

⁵See Balanced Approach and Improved R&D Management Needed to Achieve Energy Efficiency Objectives (GAO/T-RCED-91-36, April 17, 1991); Full Disclosure of National Energy Strategy Analyses Needed to Enhance Strategy's Credibility (GAO/T-RCED-91-76, July 8, 1991); and Energy Policy: Evolution of DOE's Process for Developing a National Energy Strategy (GAO/RCED-91-76, Feb. 21, 1991)

In conjunction with developing the NES, DOE began a strategic planning initiative to improve priority-setting for the department. The initiative increases the involvement of senior department officials in a "top-down" approach that integrates with the traditional bottom-up process described earlier. The planning initiative calls for a broad strategic plan and a multiyear program plan for each program office to guide future decisions on R&D programs.

One example of a multiyear plan is that developed by the Office of Utility Technologies, which, as part of the Office of Conservation and Renewable Energy, is responsible for electric energy research. The plan describes the office's mission, objectives, and strategies and provides details for basic programs, such as photovoltaics, wind, and geothermal energy research. One research objective for the geothermal program, for example, is to double the amount of economically recoverable geothermal reserves.

R&D Ranking Process

In developing the department's fiscal year 1993 budget, the Secretary directed DOE's Office of Policy, Planning and Analysis to rank civilian energy R&D activities--accounting for approximately one-third of DOE's \$19 billion budget--according to their projected contributions to NES objectives. The process focused on the first three broad NES objectives; the fourth, enhancing environmental quality, was treated as a subobjective under each of the others.

The Office of Policy, Planning and Analysis divided the R&D activities into 39 program units--groups of activities with a common theme or focus, such as increasing industrial energy efficiency. The office then established three "portfolios" of program units, one for each of the three broad NES objectives. A six-member review panel of DOE experts was established to rank the program units. According to a Policy, Planning and Analysis official, the panel consisted of DOE personnel who had comprehensive knowledge of many different technologies and programs.

The panel collectively scored each of the program units according to a set of criteria based on NES goals and then used the resulting scores to rank them. Using funding levels derived from OMB targets as a baseline, the panel recommended increased funding for the higher-ranking programs and decreased funding for the lower-ranking ones. To keep total spending within the spending target OMB established for civilian energy R&D--about \$5.2 billion--the panel recommended reducing some program's budgets to compensate for the increases in the higher-ranked programs. At the end of this statement, we have included a table which compares, for each program unit, the OMB budget targets, the Office of Policy, Planning and Analysis' recommended emphasis, and other fiscal year 1993 budget figures.

The Office of Policy, Planning and Analysis used the results of this process to advise the Secretary, recommending that DOE emphasize programs to reduce the nation's vulnerability to oil supply disruptions. To support this emphasis and remain within the OMB target, the office proposed to shift \$200 million (or about 4 percent of the \$5.2 billion civilian R&D budget) from the portfolio aimed at increasing electricity supply and demand efficiency to the portfolio aimed at reducing economic vulnerability to oil supply disruptions.

It is difficult to determine the precise effect of this ranking process on the budget that DOE submitted to OMB. While the Office of Policy, Planning and Analysis recommended a budget shift within the overall OMB target, DOE's budget request exceeded the OMB target by \$60 million. In addition, according to Policy, Planning and Analysis officials, the ranking process was not meant to recommend specific funding levels for individual program units but rather a relative funding emphasis, based on the objectives of the NES. Also, recommendations based on the portfolio process were only one of several inputs to the Secretary.

After this first use of the ranking process, DOE officials told us that they have identified potential improvements for future budget years, including

- making objective comparisons between technologies easier;
- tying the criteria upon which programs are ranked more closely to the NES;
- using more specific program categories, such as wind energy research, rather than a more general category that includes all renewable electric technologies; and
- better recognizing the trade-offs between long-term and short-term R&D activities.

OMB officials told us that DOE more carefully considered the allocation of its R&D funds for the fiscal year 1993 budget request than in past years. They attributed this to the NES and the Secretary's increased emphasis on strategic planning.

We believe that, in concept, the processes that DOE initiated in developing the fiscal year 1993 budget request represent a more systematic approach to determining budget priorities and thus an improvement over past practices. The strategic planning initiative calls for specific objectives that relate DOE R&D programs (as well as other programs) to overall departmental objectives, and specifically states that budget priorities should be linked to the plans. Continued use of the strategic planning process and the

improvements to the budgeting process that DOE identified, if implemented, can further improve DOE's allocation of R&D funding.

DETERMINING FUNDING ALLOCATIONS AMONG RENEWABLE ENERGY TECHNOLOGY PROGRAMS

Within the Office of Conservation and Renewable Energy, budget allocations are determined by the Assistant Secretary. Each of the five Conservation and Renewable Energy offices (Utility Technologies, Building Technologies, Industrial Technologies, Transportation Technologies, and Technical and Financial Assistance) develops a proposed budget for the Assistant Secretary's review. The proposals are based on a process that incorporates the strategic and multiyear program plans and the views of national laboratories, renewable energy industries, and end-users of renewable energy. With advice from the Office of Planning and Assessment, the principal Deputy Assistant Secretary, and the Office of Management and Resources, the Assistant Secretary reviews each program office's budget and decides funding levels.

To obtain national laboratories' views on priorities for the fiscal year 1993 budget, the Conservation and Renewable Energy Planning Office asked representatives from all of the DOE laboratories involved in conservation and renewable energy research to collectively rank the research programs against each other, according to the programs' anticipated contribution to NES objectives. (This process differed from the departmentwide ranking process discussed above in that, among other things, only conservation and renewable energy R&D programs were included and program units were not defined in the same way.)

Conservation and Renewable Energy management officials identified two problems in this ranking process: (1) laboratory officials might have vested interests in the particular programs they are involved with, creating a potential for bias; and (2) the scoring of programs was based on a subjective assessment of likely program impact. The Planning Office plans to develop clear definitions of NES goals for renewable energy and to specify the criteria used to judge a program's contributions.

Industry and end-user groups participate in periodic reviews of research projects at the laboratories, and DOE officials attend meetings held by various industry trade groups. The Office of Conservation and Renewable Energy also solicits from industry participants recommendations on its multiyear program plans for specific technologies. The plans, like the 1991-1995 plan for photovoltaics, incorporate industry's comments and recommendations. The completed plans are distributed to industry, utilities, and other end users.

MEETING CONGRESSIONAL DIRECTIVES

Although the Office of Conservation and Renewable Energy has no written procedures for ensuring compliance with congressional spending directives, program officials make provisions for following through on the directives. Officials told us they review congressional appropriation documents to identify such directives and incorporate them into annual operating and spending plans. Essentially, annual operating plans are agreements between DOE and its laboratories that outline projects for the year and their funding levels.

In fiscal year 1991--the most recent year for which we were able to verify that DOE had included congressional directives in its planning documents--congressional appropriations documents contained spending directives totaling approximately \$156 million, or about 36 percent of the total appropriation for conservation and renewable energy programs. To test DOE's compliance with congressional directives, we tracked five such directives in the fiscal year 1991 appropriation reports: one each in the solar building technologies, photovoltaics, biofuels, wind, and geothermal programs. In each case the funds for the congressionally directed activities were included in the annual operating plans, the spending plans, and the DOE documents that authorize transfer of funds to DOE field offices.

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This concludes my prepared statement. I will be glad to answer any questions that you or the other Members of the Subcommittee may have.

Table: Proposed Expenditures for DOE Civilian R&D at Key Stages in the Fiscal Year 1993 Budget Cycle (Dollars in Millions)

DOE Portfolio/Program Planning Units	Fiscal Year 1992 Approp.	Budget Target from OMB	Program Planning Level	Office of Policy Recommended Emphasis	DOE Request to OMB	Request to Congress
Oil vulnerability						
Transportation demand efficiency	\$ 88	\$ 109	\$ 157	\$ 157	\$ 120	\$ 125
Industrial demand efficiency	50	47	68	68	53	48
Industrial waste minimization	9	10	20	20	11	11
Transportation fuels supply	52	56	107	107	68	76
Buildings demand efficiency	25	24	61	61	28	28
Gas program	7	4	14	14	19	20
Petroleum program	57	45	68	68	55	57
Strategic Petroleum Reserve	185	195	1,249	195	198	177
Engineering and geosciences	18	18	24	18	20	20
Chemical sciences	40	52	66	52	43	44
Materials sciences	64	89	112	89	71	73
Energy biosciences	12	12	16	12	14	14
State grants	198	37	93	37	137	137
Technical assistance & deployment	13	0	8	0	11	11
Coal liquids	39	29	51	29	24	24
Naval petroleum & oil shale reserves	232	300	396	300	240	238
Total, Oil Vulnerability	1,089	1,027	2,510	1,227	1,112	1,103
Electric Efficiency						
Industrial demand efficiency	27	25	37	37	28	26
Industrial waste minimization	9	9	19	19	12	12
Utility demand efficiency	46	28	59	59	49	50
Buildings demand efficiency	25	24	65	24	29	27
Utility supply--renewables	139	139	151	139	142	144
Industry supply electric	12	19	30	19	18	15
Materials sciences	65	89	112	89	72	72
Chemical sciences	39	52	66	52	42	44
Gas program	6	4	14	4	19	20
Ultra high efficiency power systems	92	25	81	25	35	35

DOE Portfolio/Program Planning Units	Fiscal Year 1992 Approp.	Budget Target from OMB	Program Planning Level ^a	Office of Policy Recommended Emphasis	DOE Request to OMB	Request to Congress
High efficiency power systems	148	86	170	86	95	95
First repository	166	149	406	148	298	248
State grants	66	24	50	12	46	46
Monitored retrievable storage facility	16	58	71	30	58	41
Transportation, integration & engineering	34	56	71	40	53	49
Technical assistance & deployment	4	0	13	0	4	4
Clean coal	415	250	475	213	200	500
Light water reactor	63	69	69	58	59	59
Facilities--nuclear	98	101	101	85	100	95
Modular high temperature gas reactor	b	6	6	6	b	b
Advanced liquid metal reactor	60	48	77	41	54	50
Fusion energy	337	337	446	286	360	360
U-AVLIS	164	174	174	100	100	100
Total, Electric Efficiency	2,031	1,772	2,763	1,572	1,873	2,092
Fortifying Foundations						
Chemical sciences	79	104	132	132	85	87
Materials sciences	120	177	223	223	144	145
Engineering & geosciences	18	18	24	24	20	20
Energy biosciences	12	12	16	16	14	14
Biological & environmental research	353	331	392	346	371	385
Applied math sciences	81	93	93	93	91	91
University & science education	55	46	55	46	51	56
Nuclear physics	354	343	391	343	320	364
High energy physics	628	666	733	666	567	631
Superconducting super collider	484	650	650	552	650	650
Advanced energy projects	55	11	15	9	12	12
Total, Fortifying Foundations	2,239	2,451	2,724	2,450	2,325	2,455
GRAND TOTAL	\$5,359	\$5,250	\$7,997	\$5,249	\$5,310	\$5,650

^aDOE funding category which includes funding for essential activities that cannot be funded within the target level.

^bNumber included in the advanced liquid metal reactor category.
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